Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

Success Story

MOLECULAR RECOMBINATION

The research of Dr. Raymond Flannery, an Air Force Office of Scientific Research-funded physicist, may lead to important advances in the Air Force's ability to detect missiles during their boost phase. By studying the molecular recombination within and around a rocket's exhaust plume and the detailed signature information it gives off, scientists can improve missile detection capabilities. Dr. Flannery's research will also enhance the detection of satellites, warheads, and missiles reentering the atmosphere; and it will improve techniques to counter enemy detection of friendly missiles.

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Accomplishment

Dr. Raymond Flannery, Regent's Professor at the Georgia Institute of Technology, developed a microscopic theory of three-body recombination processes of electrons and ions in gases. His work gives scientists a better understanding of collisions between atoms and molecules in highly excited states.

Background

The Propulsion Directorate plans to use Dr. Flannery's research to aid in their understanding of the interactions that take place in plasma deposition and etching—the processes most often used in manufacturing large-scale integrated circuits. His work is also helpful in understanding conduction of electricity through plasmas and gases, ignition of flames, and other processes relevant to the development of advanced air and space propulsion systems.

Dr. Flannery's work will also help the Air Force continue its environmental efforts. His research will enable scientists to better understand how pollutants influence atmospheric recombination and help environmentalists to develop new methods of effectively dealing with the mitigation of these pollutants.

The Division of Atomic, Molecular, Optical and Plasma Physics of the United Kingdom's Institute of Physics recently awarded Dr. Flannery the 2002 Sir David Bates Prize in recognition of his work in the field of theoretical atomic physics and for his studies of recombination processes with applications to astrophysics and plasma physics. He was also the winner of the 1998 Allis Prize, awarded by the American Physical Society, for his work on ionized gases.

His current research includes development of theories of Rydberg plasmas and the formation of anti-hydrogen by three-body recombination. In particular, he has recently solved, with his graduate student, a 40-year-old problem explaining the mixing of angular momentum substates of a Rydberg atom by the time-dependent electric field generated by collision with a charged ion—a process known as collision Stark mixing. The process is of basic significance to Rydberg plasmas, whether at high-temperature or ultra-cold energy regimes.

Office of Scientific Research
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Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (03-OSR-13)